December 12, 2019

VERMONT PUBLIC SERVICE DEPARTMENT

RATE DESIGN INITIATIVE / DISTRIBUTED ENERGY RESOURCES STUDY
STAKEHOLDER ENGAGEMENT MEETING #1

NewGen Strategies & Solutions

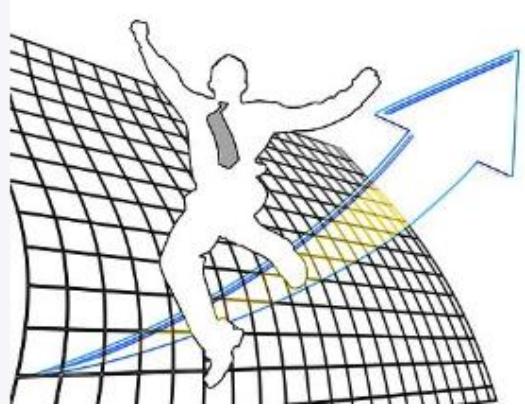
RATE DESIGN OBJECTIVE

ADVANCED RATE DESIGN

Use utility **price signals, incentives, and other inducements** to **leverage technology and new business models** in order to better advance utility goals for **cost containment, renewables integration, and environmental performance** consistent with sector goals

GOALS/PRIORITIES

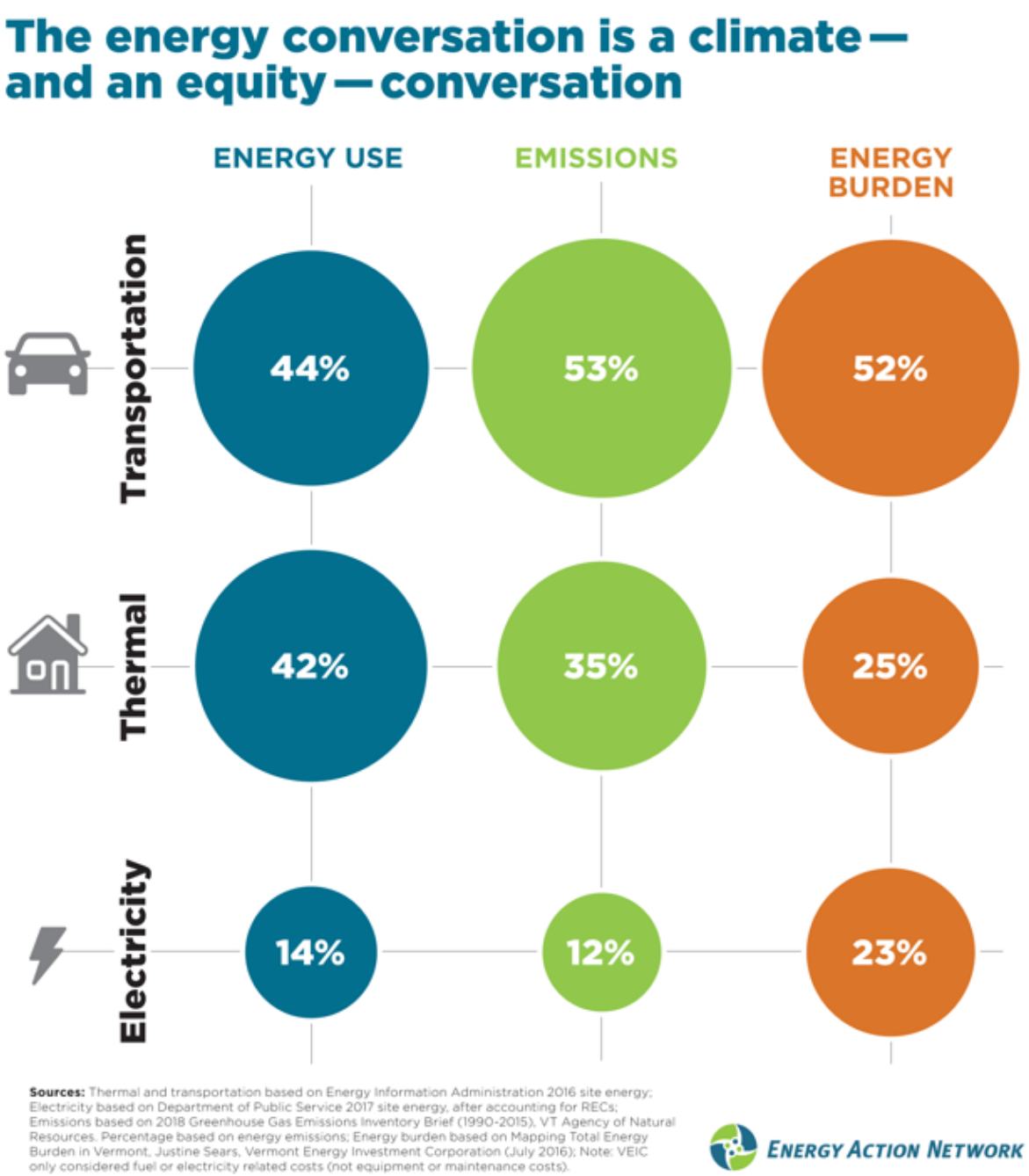
- **Administration Priorities**
  - Affordability
  - Economic Development
- **Electricity Sector Priorities**
  - System/Ratepayer costs (from what they would be otherwise be)
  - Renewable Integration
  - Carbon Reduction



ANTICIPATED OUTCOMES

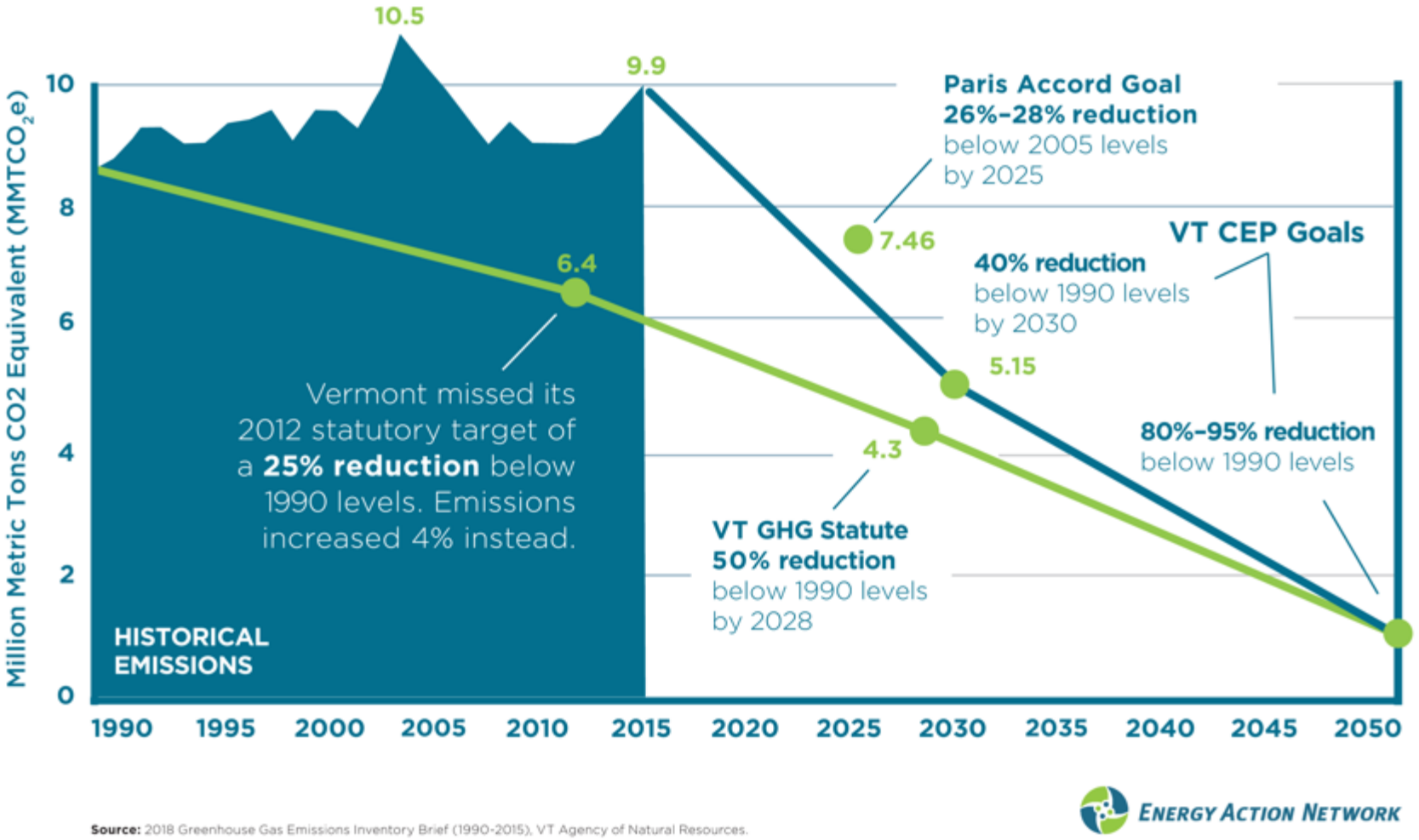
- Better load factors
- More responsive and managed loads
- Lower average system costs/rates/bills
- Better integration of renewables
- New business models for sector
- Improving environmental outcomes

TOTAL ENERGY



VT EMISSIONS HAVE BEEN RISING

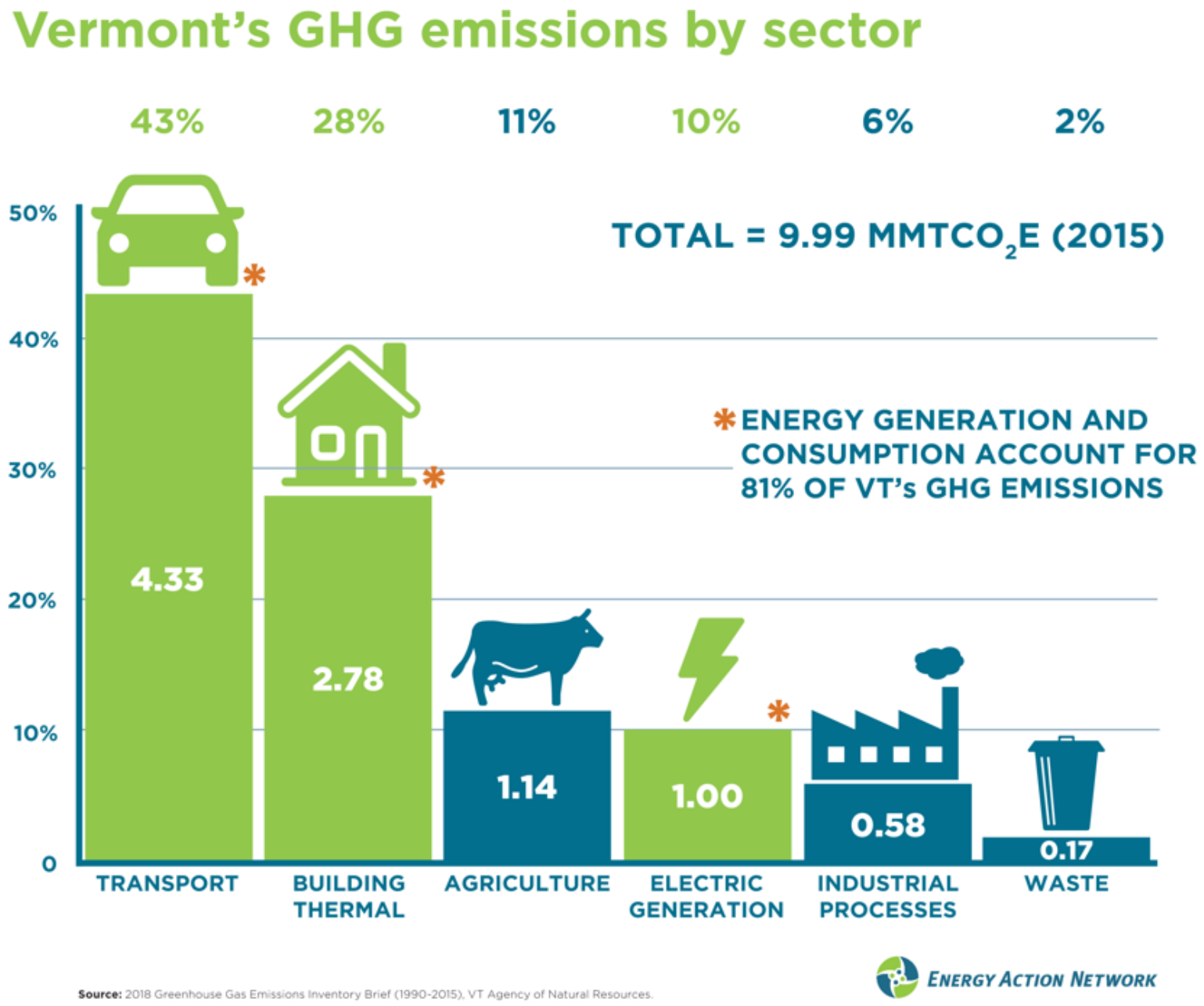
What will it take to meet our commitments?



Source: 2018 Greenhouse Gas Emissions Inventory Brief (1990-2015), VT Agency of Natural Resources.

ENERGY ACTION NETWORK

EMISSIONS


Vermont's GHG emissions by sector
43%
28%
11%
10%
6%
2%
50%
40%
30%
20%
10%
0
TOTAL = 9.99 MMTCO2E (2015)
*ENERGY GENERATION AND CONSUMPTION ACCOUNT FOR 81% OF VT's GHG EMISSIONS
4.33
2.78
1.14
1.00
0.58
0.17
TRANSPORT
BUILDING THERMAL
AGRICULTURE
ELECTRIC GENERATION
INDUSTRIAL PROCESSES
WASTE
Source: 2018 Greenhouse Gas Emissions Inventory Brief (1990-2015), VT Agency of Natural Resources.
ENERGY ACTION NETWORK

RATE DESIGN AND LARGE USERS

Large users include:

- Manufacturing
- Recreation (e.g. ski areas)
- Commercial businesses

Electricity costs:

- High when compared to other regions of the US
- Competitive when compared with other New England States
- Increasing use (efficiently) can be advantageous to the grid and rates
  - Geographically
  - Matching use to supply

Rate Design:

- Incentive rates
- Closer match of demand pattern to lower costs and lower impacts

STAKEHOLDER WORKSHOP - AGENDA

RATE DESIGN INITIATIVE

STAKEHOLDER ENGAGEMENT MEETING AGENDA

- Introduction to Team / Study Objectives and Timeframe
- Stakeholder Engagement and Workshop Process
- Facilitated Discussion: Industry and Regional Energy Rate Trends
  - Synthesis of Rate Trends by Technology
- Introduction to LSAM™
- Breakout Exercise #1 – Leveraging Rates to Deliver Value
- Lunch Break
- Breakout Exercise #2 – Development of Key Performance Indicators (KPI)/ Critical Success Factors
- Session Wrap Up / Call for Volunteers and Homework Assignments

INTRODUCTIONS / STUDY ROLES

INTRODUCTIONS / STUDY ROLES

Scott Burnham

Project Role: Project Manager

- Over 20 years of experience in the areas of project management, COS and rate design, asset valuation, and financial feasibility analysis
- Well versed in cost allocation theories and methodologies, and rate design concepts and approaches
- Co-leads the semi-annual EUCI Cost of Service and Rate Design course

Tony Georgis

Project Role: Facilitation Lead

- Over 20 years of experience in engineering economic analyses for energy, water, and wastewater resource industries
- Extensive public process experience including stakeholder engagement, education, and training
- Supported expert witness testimony in Texas and Indiana

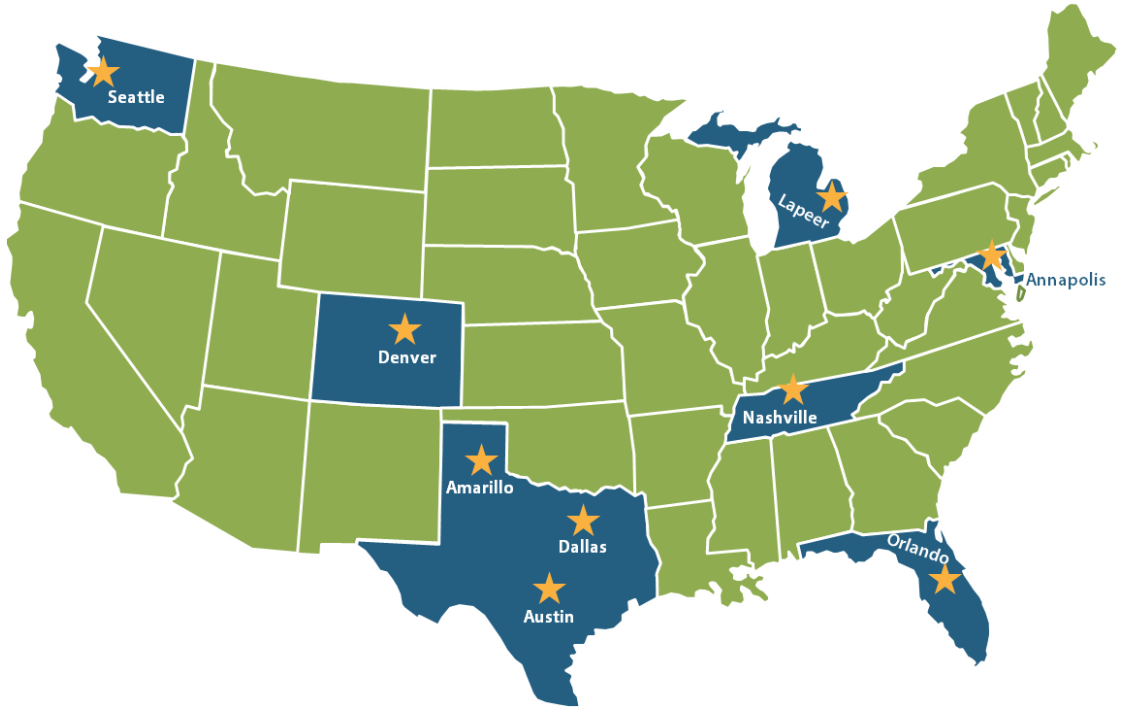
Andy Reger

Project Role: LSAM™

- Over 9 years of experience in the energy industry
- Led development of NewGen's proprietary LSAM™ load shape forecasting model
- Experience with working with utilities on community solar program evaluation, design, and deployment

NEWGEN OVERVIEW

Thoughtful Decision Making for Uncertain Times



Founded in 2012, we are a national consulting firm focused on utility industry with more than 40 staff across the country

OBJECTIVES / TIMEFRAME

STUDY OBJECTIVES

- Underlying factors influencing Study objectives
  - Define “innovative” rates
  - Engage utilities and stakeholders within Vermont to enhance success
  - Measuring successful outcomes:
    - Comprehensive Energy Plan
    - Alignment with VT Utility strategies
    - Define Key Performance Indicators (KPIs) and critical success factors

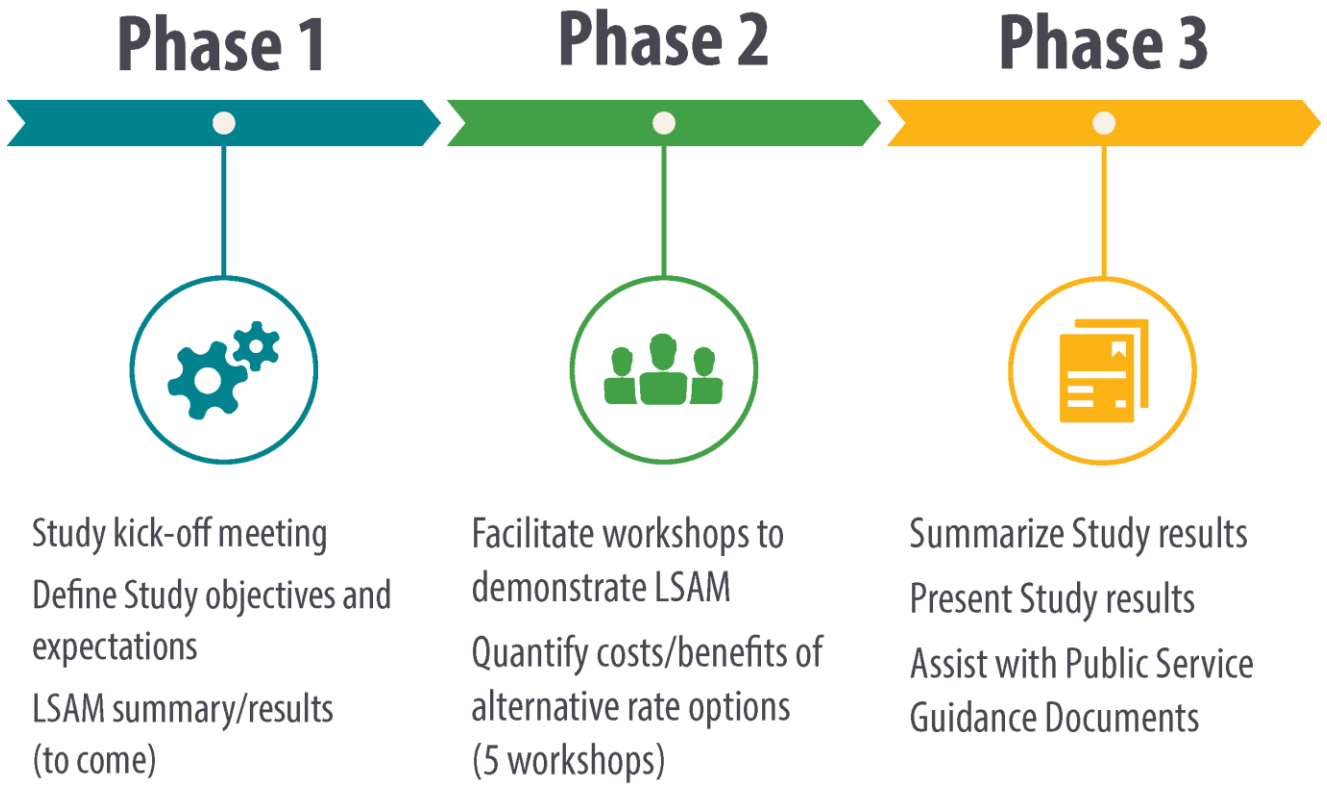
STUDY OBJECTIVES

Define "innovative" rates for purposes of Study modeling

- Electric Vehicles Public Charging Station Rates
- Electric Vehicle at Home Charging Rates
- Photovoltaic (PV) Rates
- Thermal Storage Rates
- Battery Storage Rates
- Time-differentiated Rates

STUDY TIMEFRAME

- September 15, 2019 – May 29, 2020



STAKEHOLDER ENGAGEMENT AND WORKSHOP PROCESS

STUDY OBJECTIVES

- Develop a series of facilitated **stakeholder engagements** with utility management and staff, energy service companies, interested regulators, and consumer / environmental interests
  - Explore / model potential new retail rate designs
  - Quantify rate impacts to customer / utility / system
  - Summarize workshop discussions, decisions, and outcomes

STAKEHOLDER WORKSHOP #1

DECEMBER 12, 2019

- Workshop #1: Focus on project objectives and soliciting insights from stakeholders
  - Subsequent workshops will be more detailed and quantitative
- Expectations / objectives
  - Develop common project understanding
  - Role of Department / NewGen
  - LSAM™ example and demonstration
  - Solicit strategic insights and feedback
  - Participant engagement

FUTURE STAKEHOLDER ENGAGEMENT EVENTS

- Event #2 (January 2020)
  - Discuss timing with State Legislature
  - More hands-on, analytical
  - Focus on short-term conditions in market (as defined)
- Event #3 (March 2020)
  - Results of detailed analysis by utility
  - Incorporate feedback
  - Focus on mid-term conditions in market (as defined)
- Event #4 (April 2020)
  - Results of detailed analysis by utility
  - Incorporate feedback
  - Focus on long-term conditions in market (as defined)
- Event #5 (May 2020)
  - Focus on higher level (invite policy / decision makers)
  - Summary of results
  - Accomplishment of Study objectives
  - Next steps

STUDY ELEMENTS

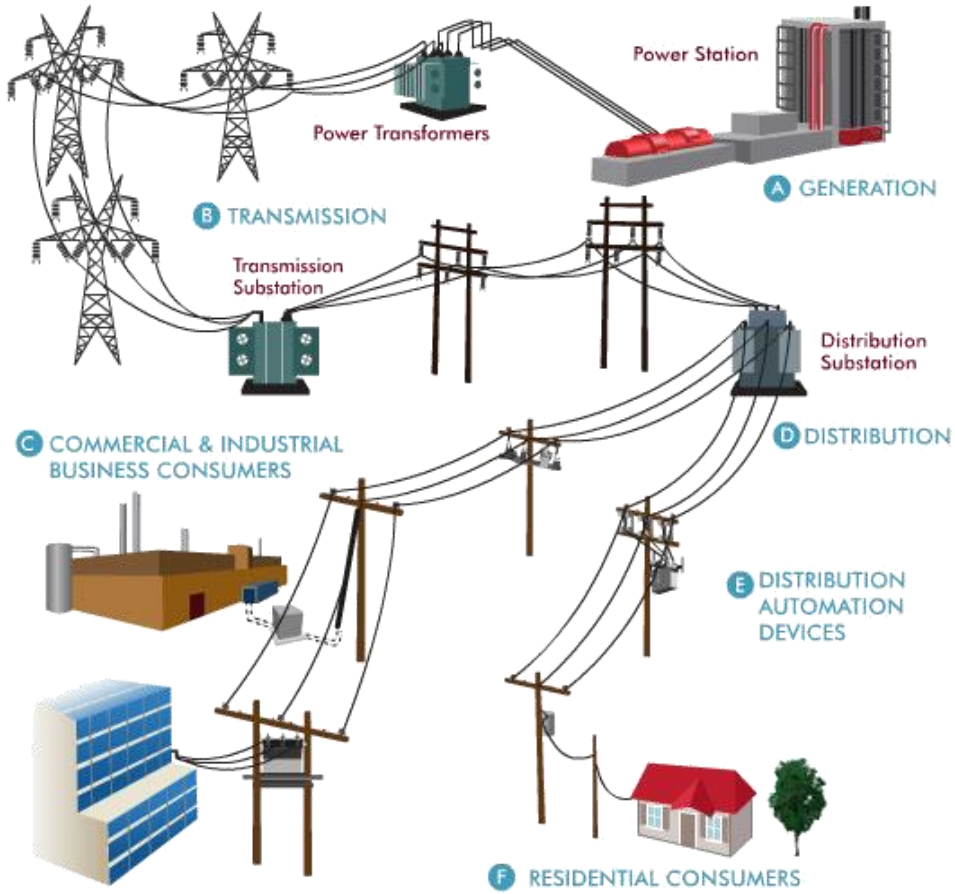
DEFINE TIMEFRAME FOR STUDY EVALUATION

Each term will have varied conditions on the system (e.g., DERs, EV, etc.)

INDUSTRY AND REGIONAL ENERGY RATE TRENDS (FACILITATED DISCUSSION)

THE ELECTRIC INDUSTRY IS EVOLVING

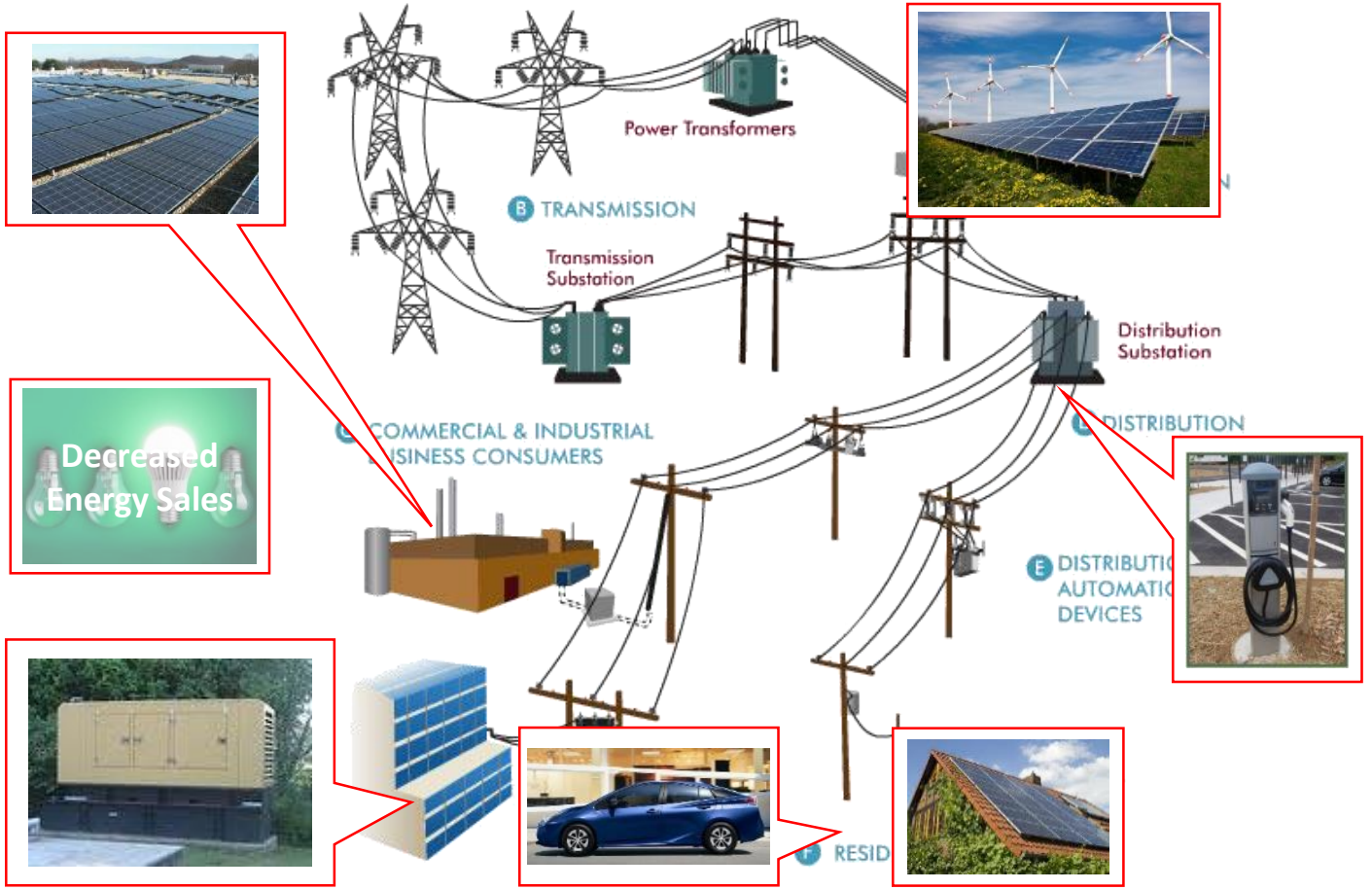
<u>The Old Paradigm</u>
Safe, Reliable Power
at Least Cost



THE ELECTRIC INDUSTRY IS EVOLVING

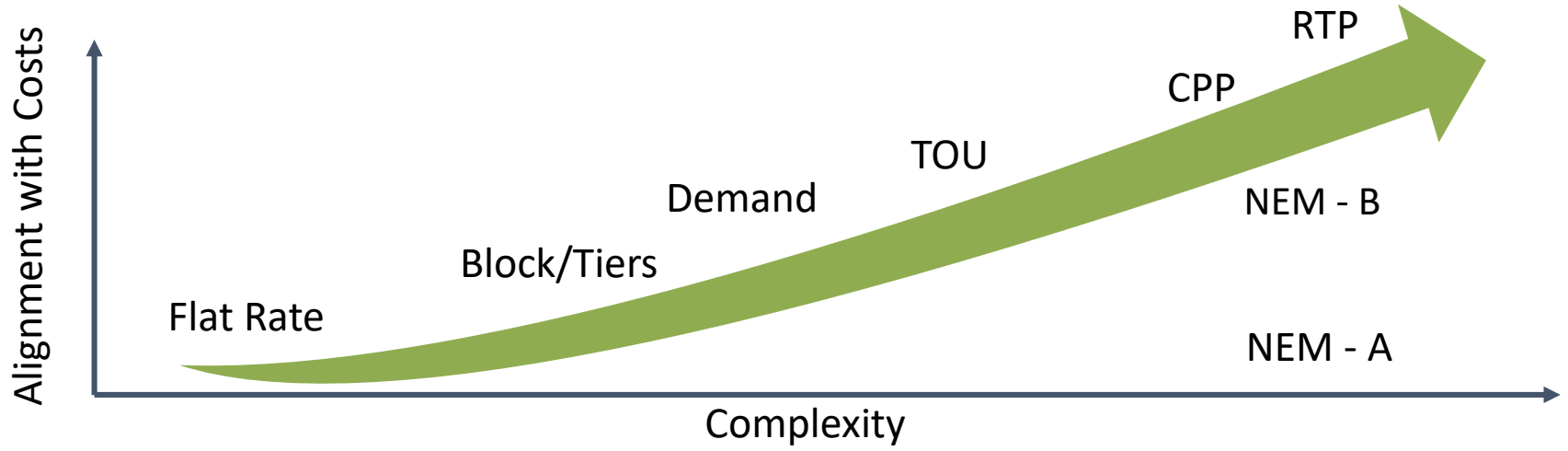
The New Paradigm

Safe, Clean, Reliable Power at Least Cost Allowing Customer Flexibility



RATES ARE EVOLVING TO ALIGN WITH THE NEW PARADIGM

- Key link to incentivize behavior and drive optimization
- AMI penetration facilitating, driving innovation in rate making
- Using rates as a ‘resource’ in evolving load profiles
- Bridge to 3rd party vendors to automate



DISCUSSION OF INNOVATIVE RATES

UTILITIES

- Burlington Electric Department – James Gibbons
- Green Mountain Power – Scott Anderson
- Vermont Electric Coop – Katie Orost
- Washington Electric Coop – Patty Richards

DISCUSSION OF INNOVATIVE RATES

NGOS / 3RD PARTY SERVICE PROVIDERS

- Regulatory Assistance Project – Rick Weston
- Peck Electric – Steve Yates
- Associated Industries of Vermont – Bill Driscoll
- Dynamic Organics – Morgan Casella

THIRD PARTY – VALUE-ADDED SERVICE TYPES

- Third-party / value added services
  - Leap and Google Nest providing residential flexibility in the wholesale market
- EV services (i.e. fleet management, charging stations)
- Customized energy products to meet customer demand for renewable energy
- Integrated energy management solutions
  - Powerley and DTE (Michigan)
- Private and/or community solar
  - Clean Energy Collective and Xcel Energy
- Energy efficiency products
  - Simple Energy and ComEd EE Products
- Energy storage products

SYNTHESIS OF RATE TRENDS BY TECHNOLOGY

INDUSTRY PRACTICES / TRENDS IN RATE MAKING

- EV Rates
  - Austin Energy's flat rate EV home charging program with access to public charging station network
- Time differentiated rates (RTP, CPP, TOU)
  - Oklahoma Gas and Electric Variable Peak Pricing Program
- NM Successor / NM 2.0 or 3.0 Rates
  - Hawaiian Electrics' multitude of solar programs to fit every customers needs while encouraging grid stabilization
- Storage Rates
  - Eversource's Connected Solution battery storage program

EV PUBLIC CHARGING RATE RESEARCH

Synthesis: Subscription rates; strong energy price signal; fixed cost recovery; incentivizing EV charger installation and public charging through discounted rates

- Examples
  - No demand charge or phased-in demand charge once utilization increases
  - Adders during peak hours to collect a portion of capacity related costs
  - TOU Energy Rates, especially when solar can be utilized
  - Capacity based monthly customer charge to replace demand rates
  - Phasing out level 1 chargers

EV HOME CHARGING RATE RESEARCH

Synthesis: Strong energy price signaling to charge overnight, during the day, or other off-peak times; incentivizing EV adoption through rebates and rates

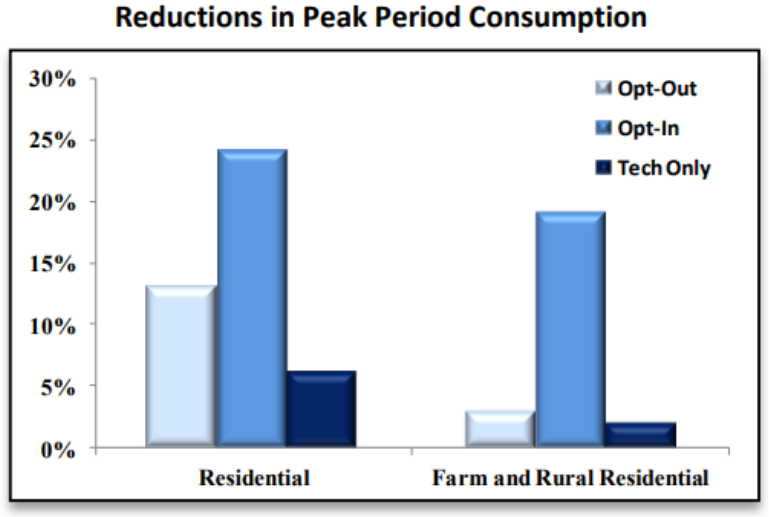
- Examples
  - TOU Energy Charge
  - Demand Charge
  - Flat rate monthly credit
  - Rebates for installing an at home charger
  - Pilot program for new technologies
  - Flat rate off-peak charging
  - Blocked season energy rates
  - Tiered customer charge based on energy usage
  - Critical Peak Pricing
  - Annually decreasing discount to current rates
  - Separate meter option vs whole house meters

RESIDENTIAL TIME DIFFERENTIATED RATES

STICK: CRITICAL PEAK PRICING

Synthesis: Less common; utilities provide day-ahead notification; energy rates significantly increase during event days; no baseline load calculations required

- Less common compared to PTR programs
- Provide day-ahead notification of critical peak event
  - Energy prices are constant event-to-event
  - Prices are typically >> 100% above non-peak energy rates
  - Events range from 3 – 7 hours
- Typical number of events allowed: 10 – 20
  - Utilities may restrict events to the summer season
  - Year-round programs allow for a greater number of events
- Example utilities:
  - Sioux Valley Energy (SD)
  - New Jersey Public Service Electric and Gas Company
  - Sacramento Municipal Utility District



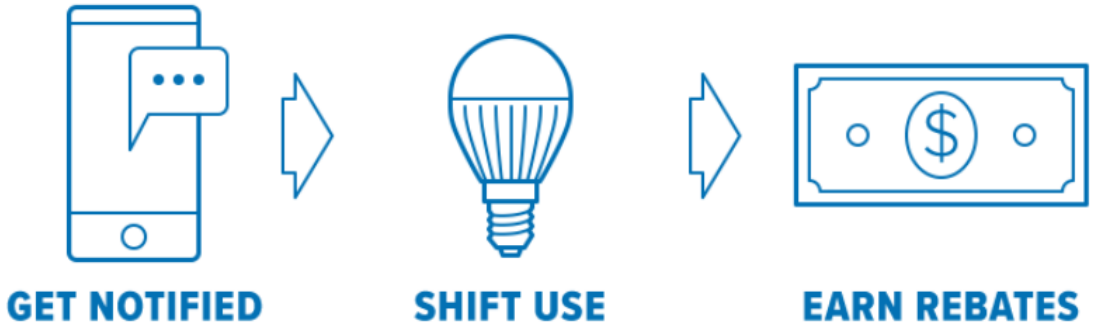
Reductions in load can vary dramatically based on how customers come to the program.
Tech refers to utility-controlled load (passive from customer perspective)
Sioux Valley Energy

RESIDENTIAL TIME DIFFERENTIATED RATES

CARROT: PEAK PERIOD REBATES

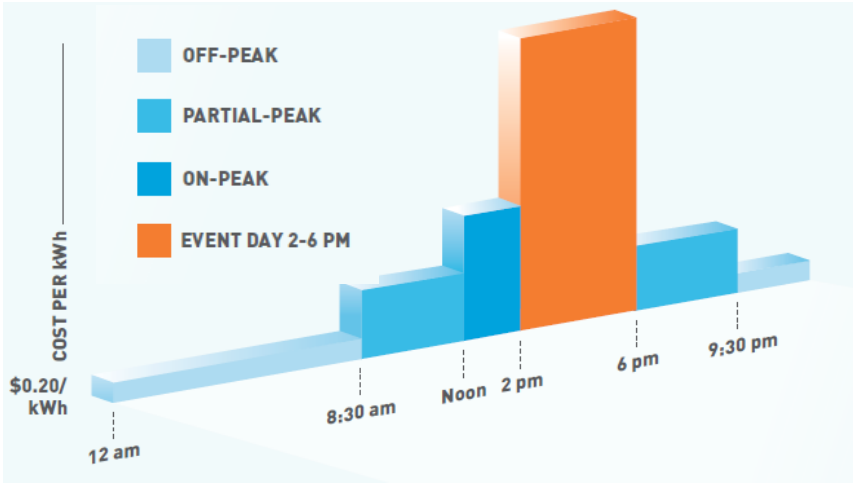
Synthesis: Most common of these programs; utilities provide day ahead notification; rebates given for shifting/reducing consumption; requires estimation of customers base-line load

- Programs provide day-ahead notification of an event day
- Number of events typically between 6 – 20
  - Utilities may restrict events to the summer season
  - Year-round programs allow for a greater number of events
- Timespan of events vary
  - Portland General Electric: 3- or 4-hour events
  - Delmarva Power: Up to 6-hours in duration between 12 – 8 PM
  - Baltimore Gas & Electric: 1 PM - 7 PM
- Rebate calculated based on estimated reduction in load during event
  - Ongoing challenge to accurately estimate customers' baseline load
- Most common of residential dynamic pricing programs

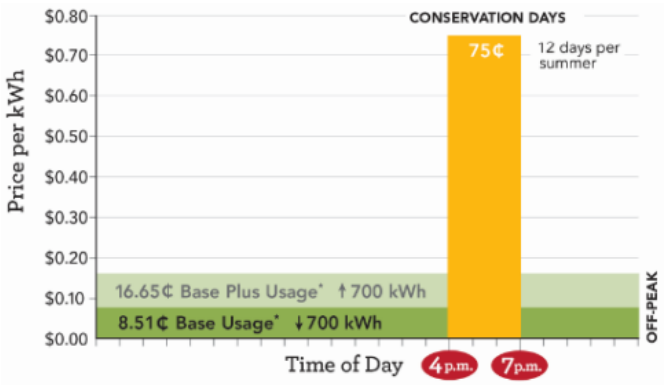


From Portland General Electric

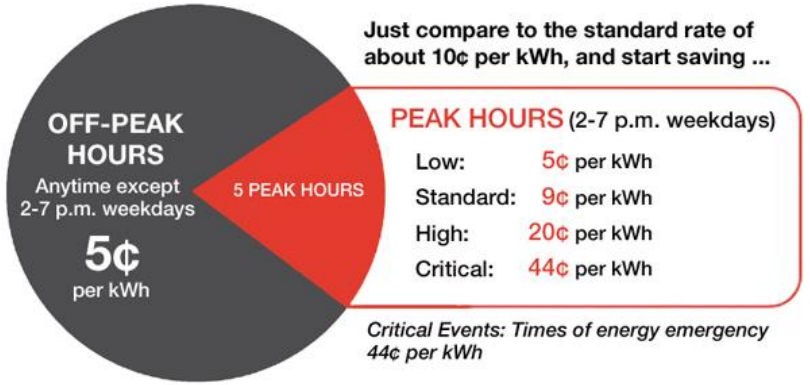
RESIDENTIAL TIME DIFFERENTIATED RATE PROGRAMS



From Pacific Gas & Electric



From Sacramento Municipal Utility District



From Oklahoma Gas & Electric

Alignment with Vermont market? Lessons learned so far by utilities, state, 3rd parities?
Any substantial barriers to widespread pricing signals aligned in State?

COMMERCIAL DYNAMIC PRICING PROGRAMS AND SUMMARY

Synthesis: CPP programs are most common; follow similar structure to residential programs; utilities may see less percent reduction compared to residential

Summary:
Residential programs see ~ 12-20% reduction

C/I programs see < 10% though less information available

- Provide day-ahead notification of critical events
  - Allow between 10-20 events year-round
  - Event durations vary but typically limited to occur in the afternoon
- Typically offered for most C/I customers
  - Largest load reductions seen in largest customers

- What response have VT utilities seen from Residential / Commercial CPP programs?
  - Room for additional adoption in Commercial space?
- What approach is more effective?
  - Carrot vs. Stick

What /how have Vermont C&I customers responded? How flexible are they if critical periods shift?

NET METERING RATES

TRENDS IN PV AND DISTRIBUTED ENERGY RATE DESIGN

Synthesis: Utility's objectives fall into 3 categories cost recovery, incentivize adoption, or a combined, middle ground approach

- **Cost Recovery**
  - Capacity based standby charges
  - Net metering banks or solar banks
  - Volumetric Incentive Rates / Bidding
  - Value of Solar (VoS Rate)
  - Increased fixed charges
- **Combined Approach**
  - TOU
  - Real Time Pricing
  - Seasonal Rates
- **Incentivize Adoption**
  - Rebates
  - Higher energy rates
  - Payouts

TRENDS IN BATTERY STORAGES RATES

Synthesis: Battery storage rate design and programs not widely implemented; growing interest and adoption; utility control of dispatching provides larger benefits to the grid; incentivizing equipment installation

- Examples
  - Extensive research in the industry
  - States executing battery storage legislation
  - Equipment rebates
  - Incentives and programs
    - Credits that are trued up at years end
    - Takes advantage of TOU rates
    - Seasonal payment
    - Incentives based on average capacity contributed

TRENDS IN THERMAL STORAGE RATES

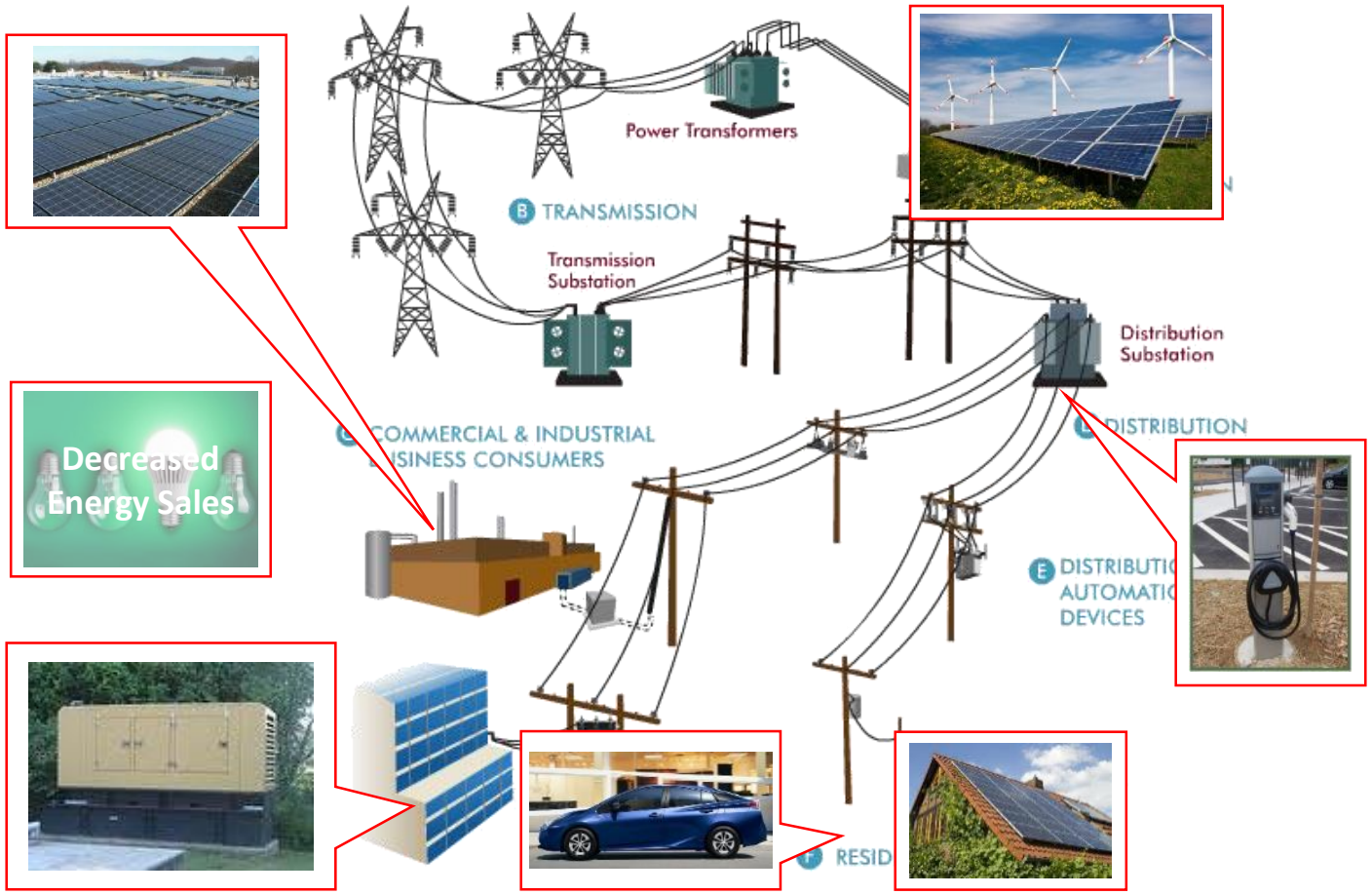
Synthesis: Thermal storage rate and programs not widely adopted; strong energy price signaling; incentivizing equipment installation; large variety of materials and system types utilized; no dominant design has emerged

United Power Program Summary: Demand response goal, equipment rebates, equipment charging automated, energy price signaling to charge overnight or in morning

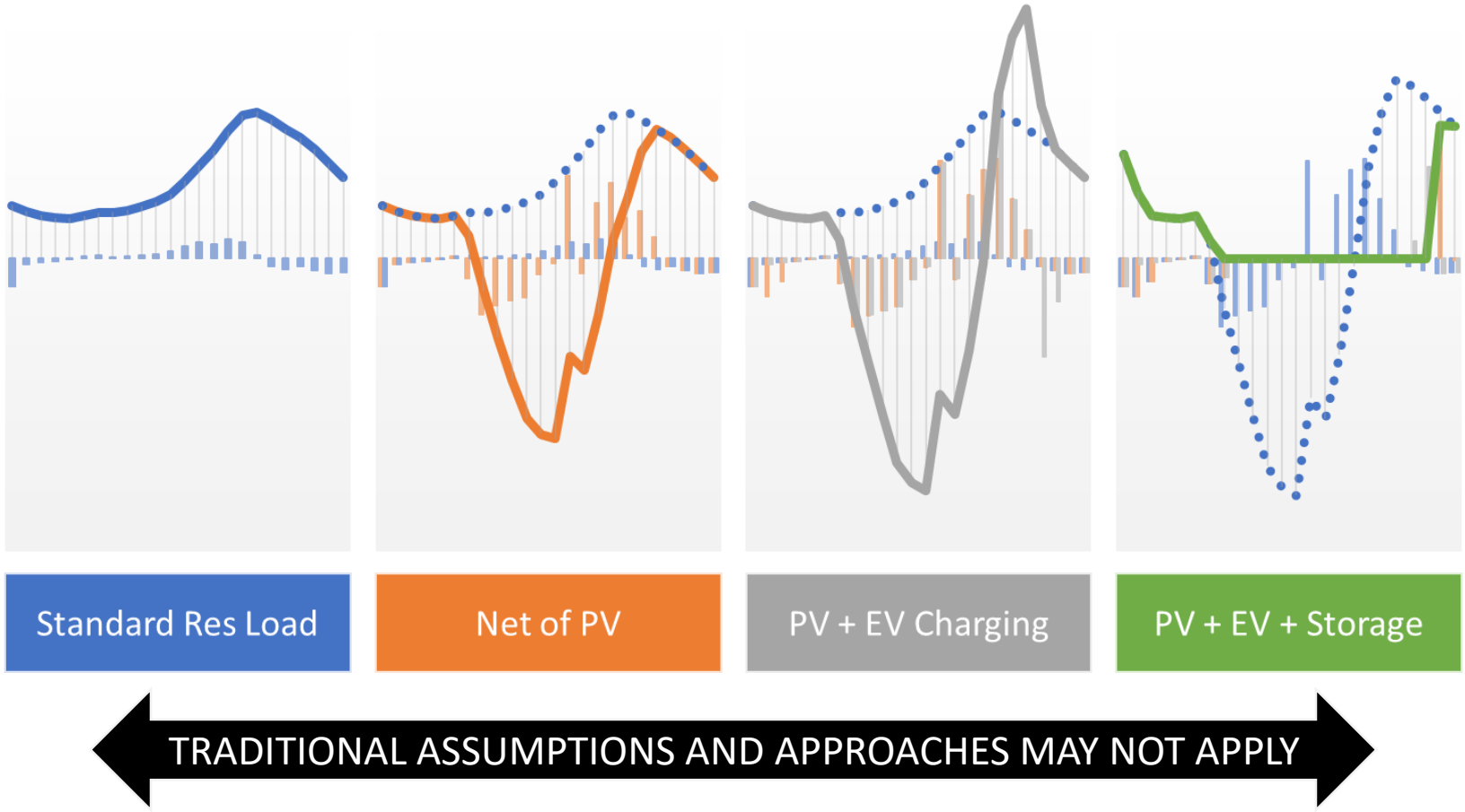
- United Power Program Details
  - Customer Charge
  - Energy
    - On-Peak
      - Monday – Saturday 2:00 P.M. to 10:00 P.M.
    - Off-Peak
      - $0.0539 per kWh
  - Demand $1.00 per kW
  - Minimum system capacity of 1 kW

DER IMPACTS AND THE LSAM™ MODEL

THE ELECTRIC INDUSTRY IS EVOLVING

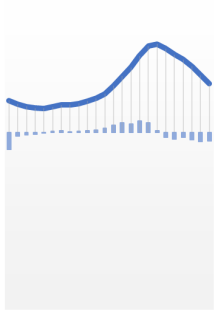


DERS ARE EVOLVING THE USE OF ELECTRICITY



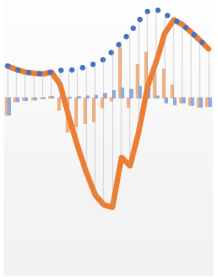
DERS ARE EVOLVING THE USE OF ELECTRICITY

Standard Res Load



- Typically, summer afternoon/evening peaking
- Sometimes diurnal shape in winter

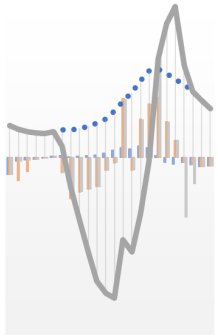
Net of PV



- Reduction in load during daylight hours
- Reduction in kWh purchases
- Smaller reduction in kW, but peak later in day

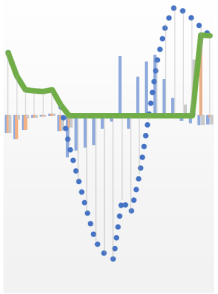
DERS ARE EVOLVING THE USE OF ELECTRICITY

PV + EV Charging



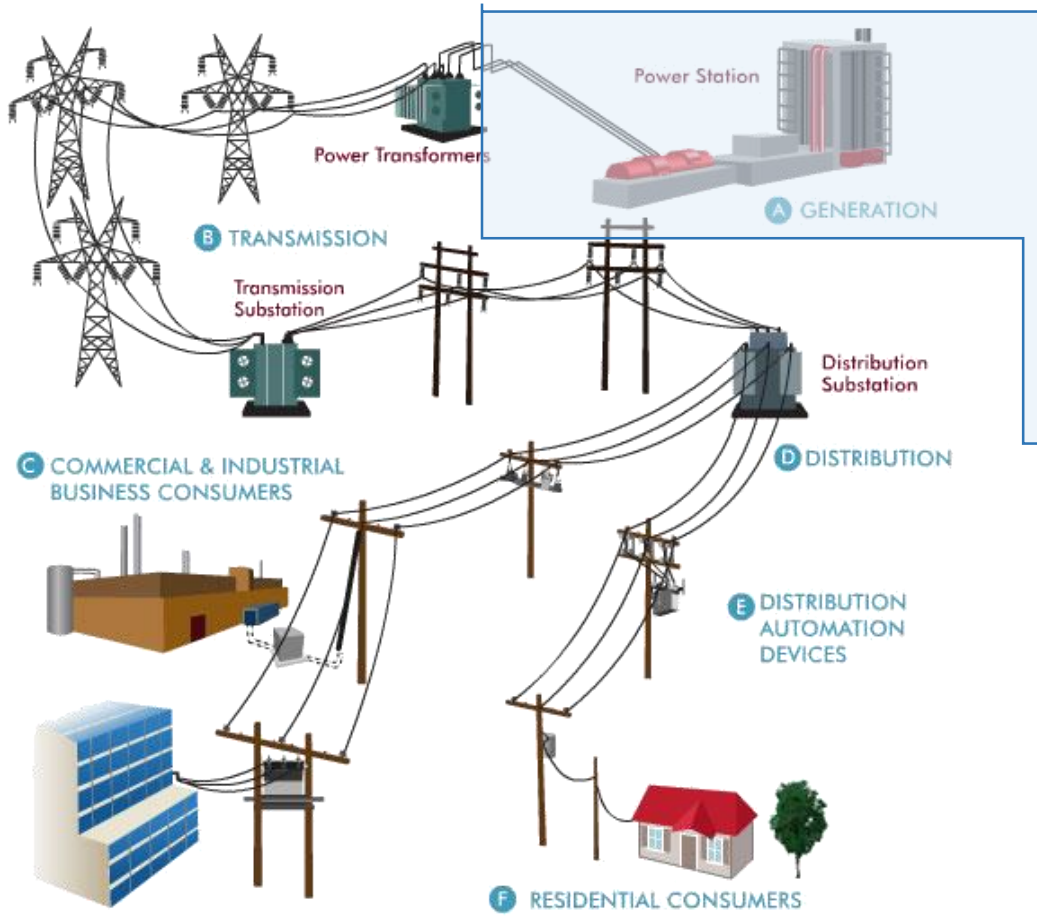
- Increased capacity requirements for faster EV charging, likely Residential afternoon/evening peak
- Increase in energy sales

PV + EV + Storage



- If BTM, storage dispatch highly dependent on rate design and customer load, which may not coincide with utility cost drivers
- If utility-controlled, more likely to benefit system

UTILITIES INCUR COSTS DIFFERENTLY BY UTILITY FUNCTION



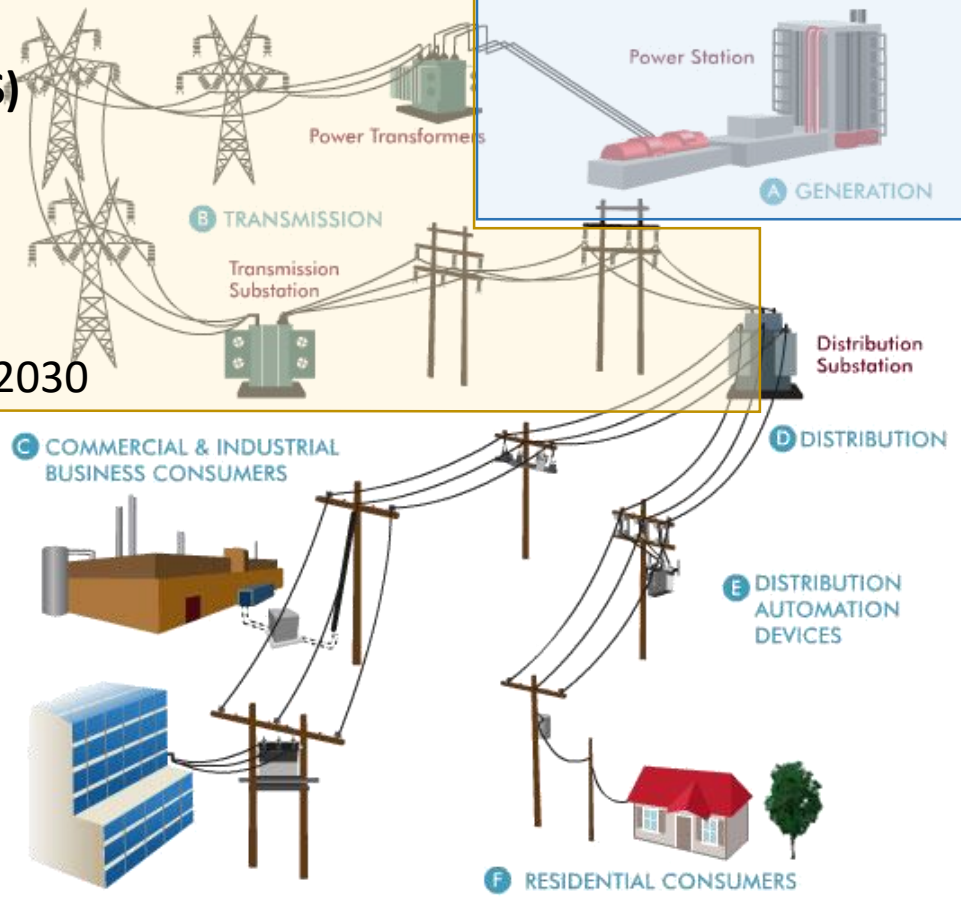
ISO-NE Power Supply Costs

- Energy: ~$0.03-$0.07/kWh Depending on Timing
- Capacity: ~$6-$7/kW During 1 ISO-NE CP Hour

UTILITIES INCUR COSTS DIFFERENTLY BY UTILITY FUNCTION

Transmission
Regional Network Service (RNS)

- Capacity: ~$110/kW-yr
  Avg. of 12 Monthly Peaks
- Forecast: Cost Increasing ~50% - 2030



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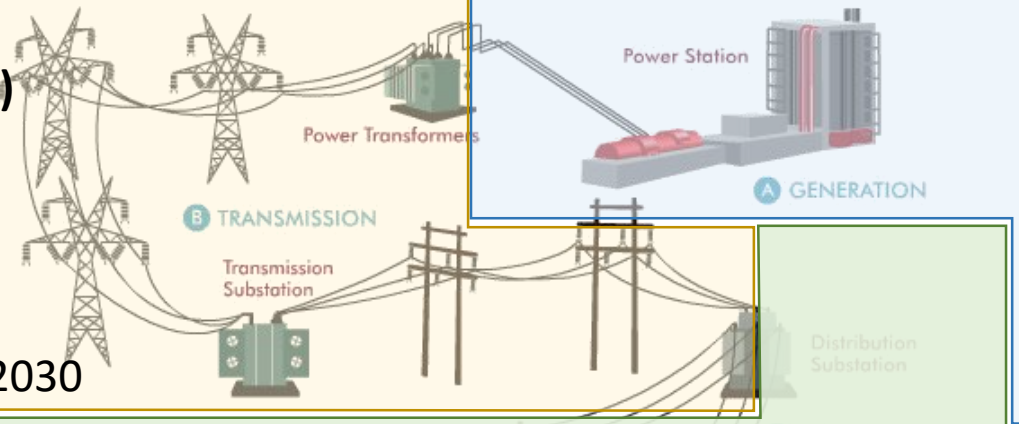

ISO-NE Power Supply Costs

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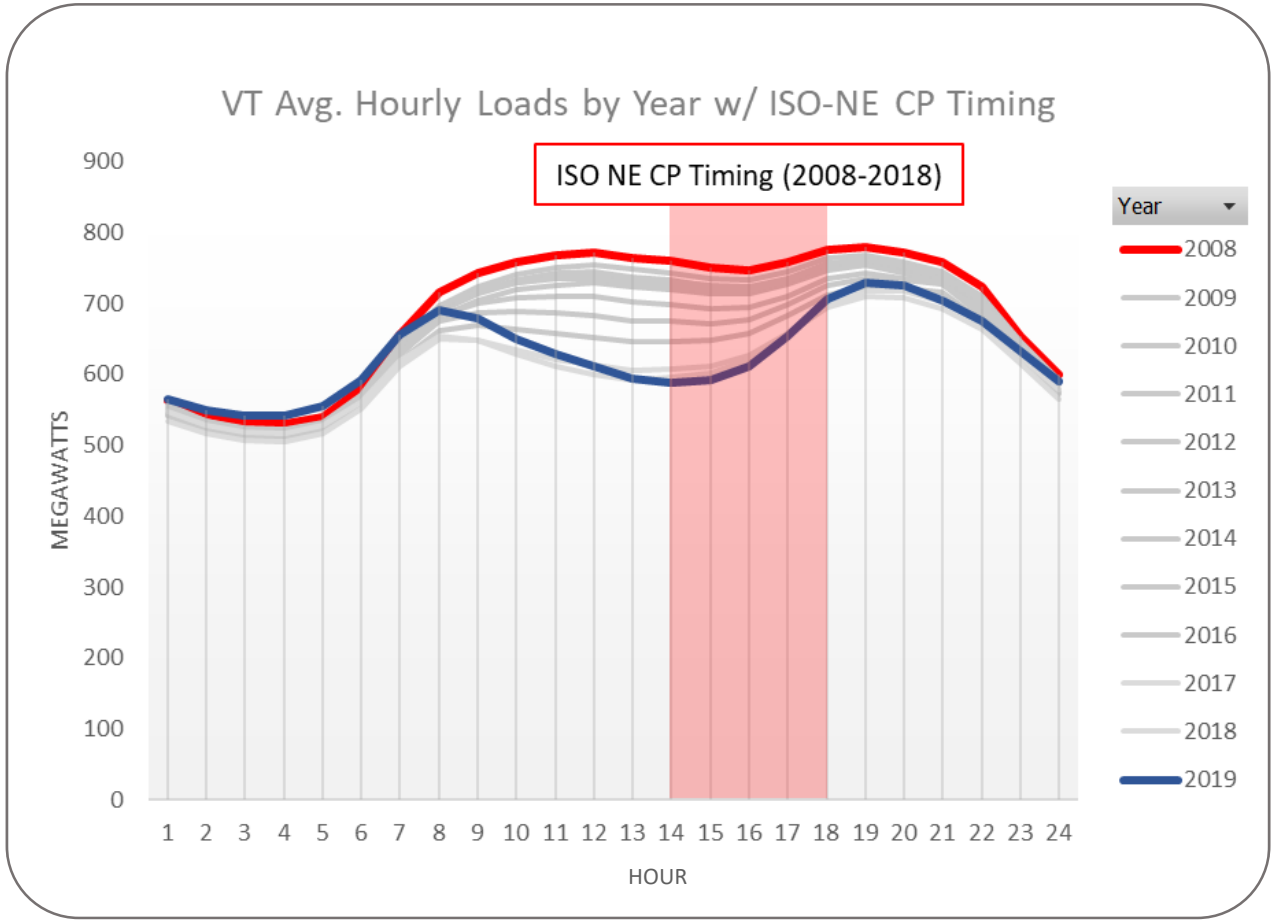
  Depending on Timing
- Capacity: ~$6-$7/kW
  During 1 ISO-NE CP Hour

Local Distribution System(s)

- Capacity: Highly Specific to Utility and Specific Location
- Cost: Driven by customer count and demand

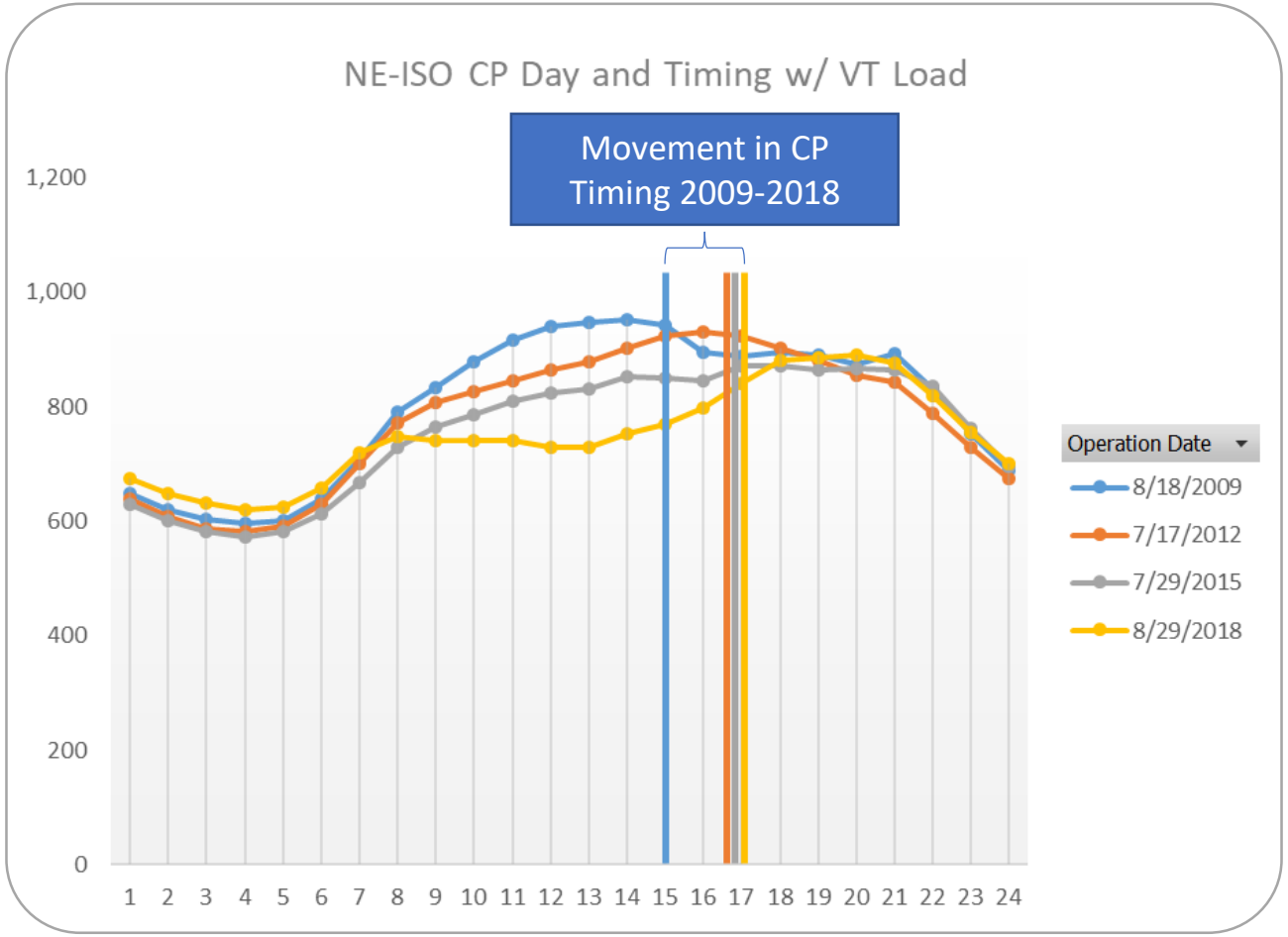
HOURLY LOADS IN VERMONT HAVE EVOLVED

- In ten years, state load during daytime hours has decreased
  - Economic downturn
  - Energy efficiency
  - ~300 MW solar installation
- Down during ISO-NE CP times
- Overall reduction in peak demand leading to RNS reduction



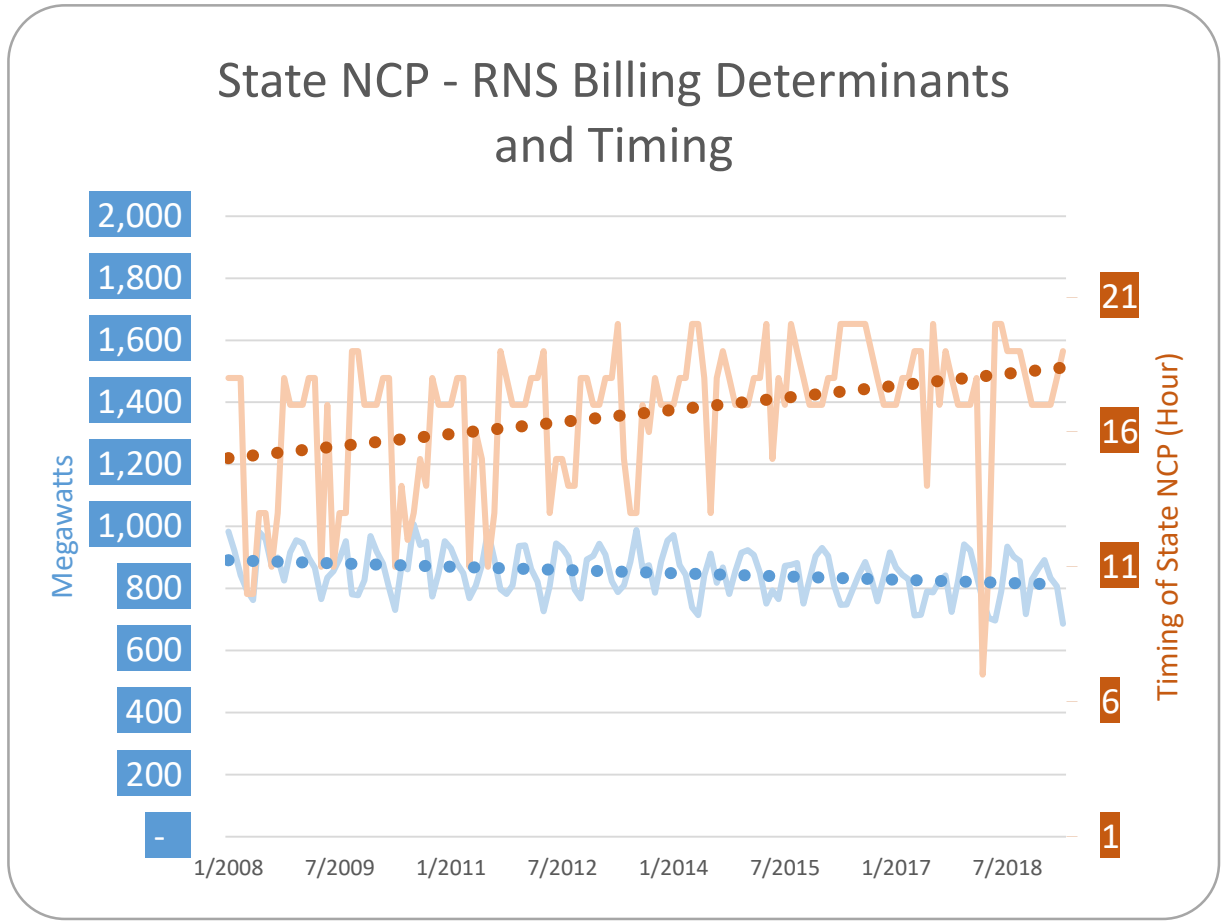
HOURLY LOADS IN VERMONT HAVE EVOLVED

- The ISO-NE CP timing is shifting later in the day
  - Since 2009, peak hour has pushed from 15:00 to 17:00
  - Likely impacts of solar generation in the ISO



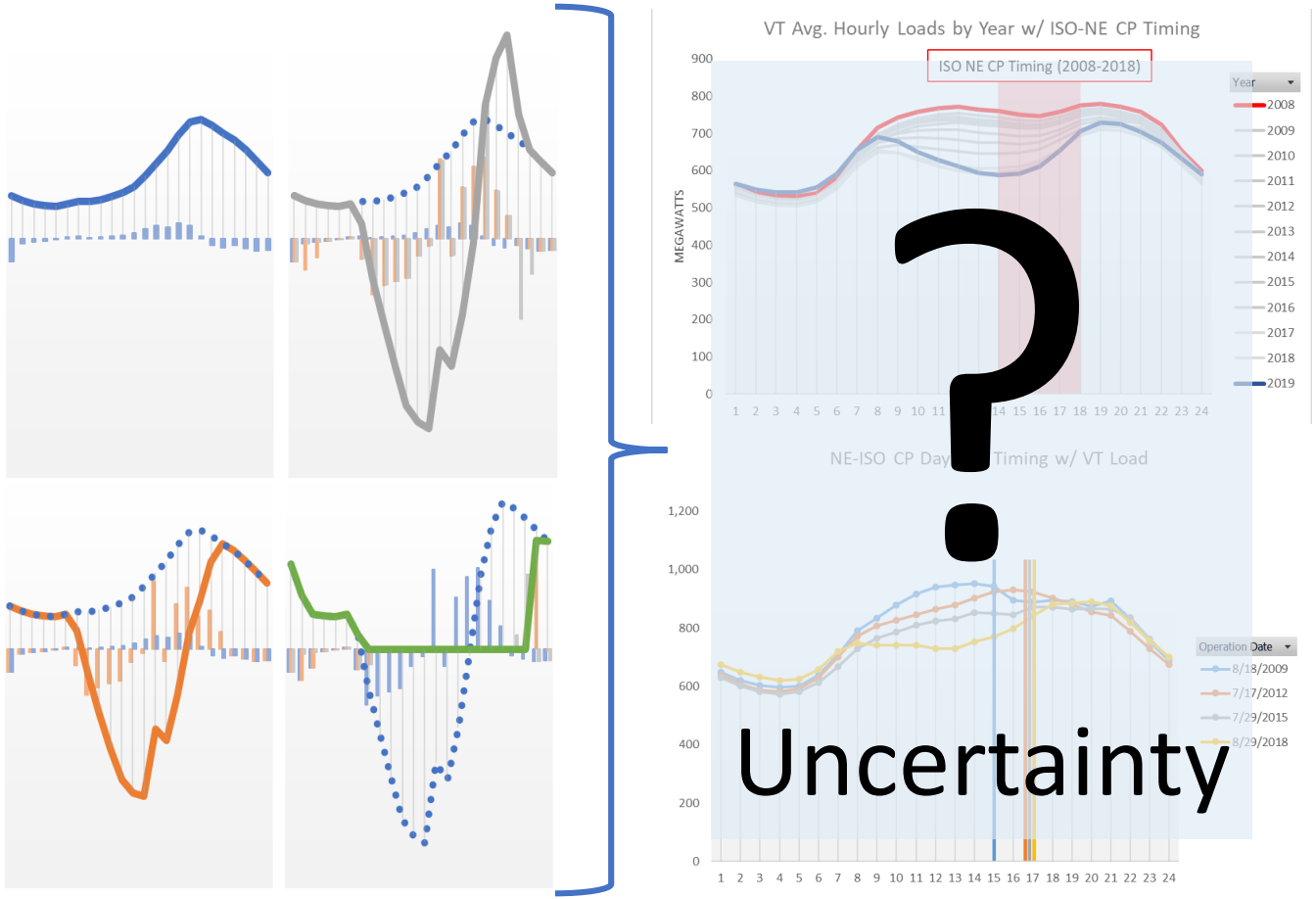
HOURLY LOADS IN VERMONT HAVE EVOLVED

- Like ISO-NE power supply billing determinants, since 2008, RNS demand has:
  - Decreased
    - ~10%-15%
  - Pushed later in the evening
    - 15:00 to 18:00



FORECASTING DERS, OTHER ELECTRIFICATION TECHNOLOGIES, AND POLICY IMPACTS

- PV, EV, Storage
  - How much and by when, and at what impact?
- Other Electrification Tech: Elec heat pumps, water heaters
- Evolution in underlying technology costs and policy framework



NEWGEN'S LOAD SHAPE ANALYSIS MODEL (LSAM™)

- Dynamic and integrated forecast of the interaction between DERs, rate design, financial planning, and resource planning
  - Forward-looking model supporting short-, medium-, and long-term planning
- Facilitates strategic decision-making through scenario and sensitivity analyses

RATE DESIGN INFLUENCES DER ADOPTION AND DRIVES USAGE PATTERNS AND UTILITY IMPACTS

Customer economics of solar is a function of installed cost, incentives, and reduced electric bills t

The timing of EV charging may be controlled using rate design and pricing signals, or directly by the utility

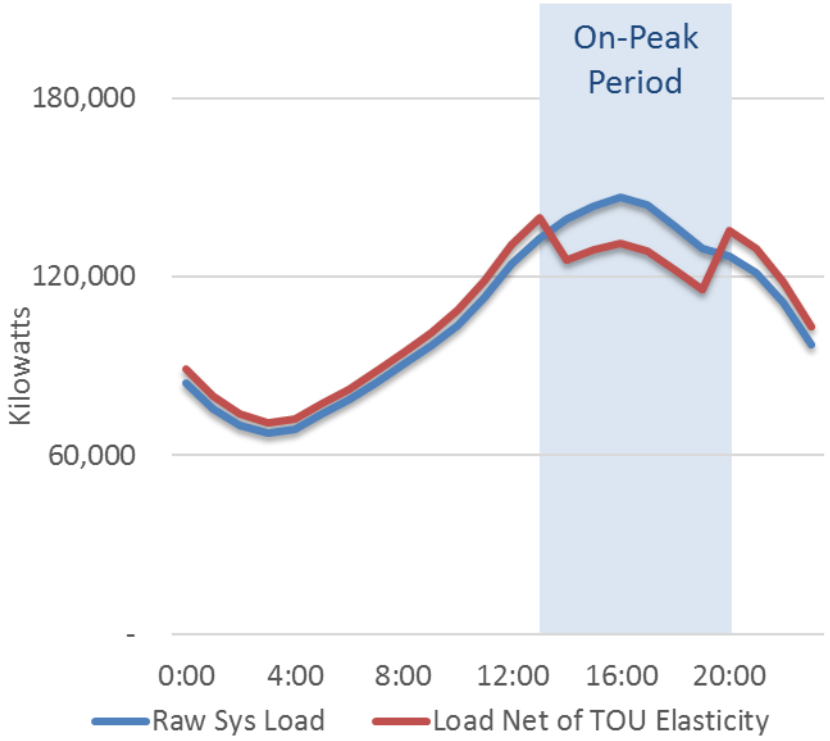
Customer-sited energy storage is a function of installed cost, incentives, and reduced electric bills

Rate design impacts the timing and magnitude of DER adoption and can control the technology's use on the electric system

“RATES AS A RESOURCE”

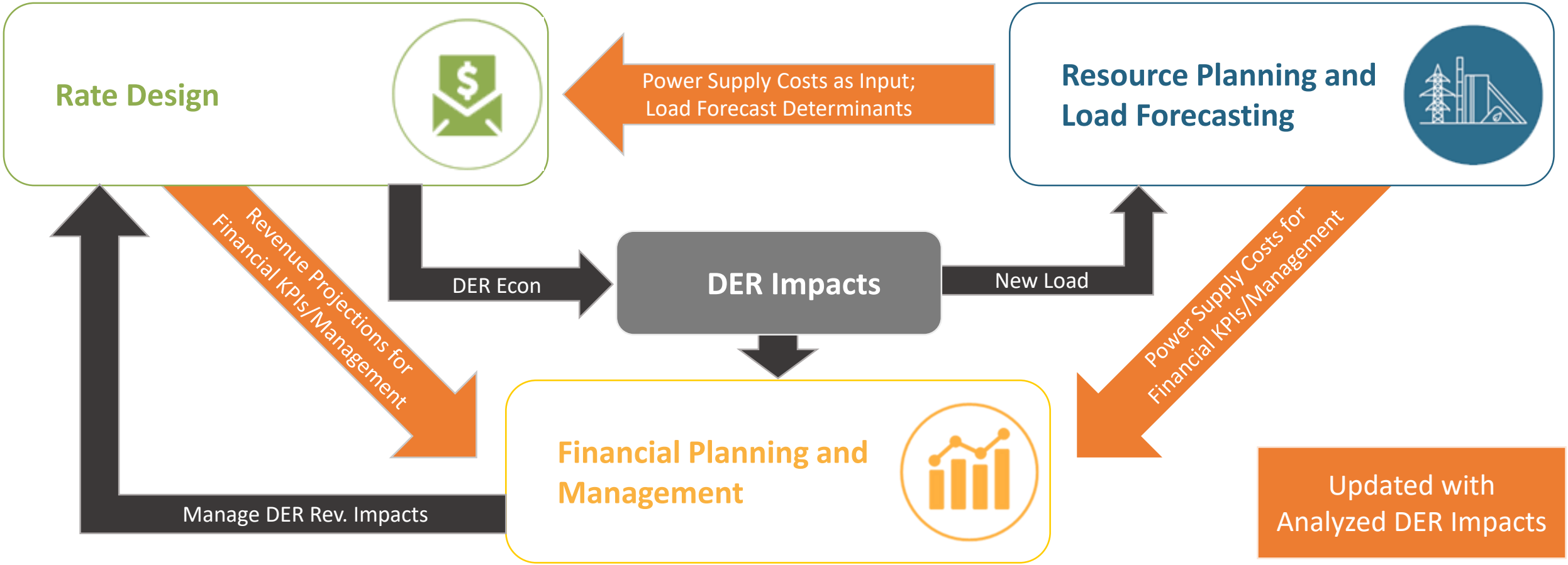
RATES CAN SIGNAL A CHANGE IN ENERGY USAGE BEHAVIOR

- Rate design with a targeted pricing signal can encourage load reduction vis-à-vis:
  - technology adoption
  - behavior change
  - or both
- Role of 3rd party load managers can improve dynamic load responsiveness



ELECTRIC UTILITY MANAGEMENT BY FUNCTION –
TRADITIONAL FLOW AND USE OF INFORMATION

ELECTRIC UTILITY MANAGEMENT BY FUNCTION –
FLOW AND USE OF ADDITIONAL AND UPDATED INFORMATION



LSAM'S ROLE IN THIS STUDY

- LSAM™ allows selected stakeholders to evaluate the impacts of new and innovative rate designs on
  - DER adoption
  - Customer class hourly load shapes and forecasts
  - Power supply costs
  - Revenue recovery and financial performance of the electric utility
- LSAM™ also allows for instantaneous evaluation of numerous scenarios and sensitivities
  - Opportunity for user customization

LSAM'S USE WITHIN WORKSHOPS

- A hosted version of the LSAM™ dashboard will be made available to selected stakeholders
  - Vermont utility-specific data being incorporated into the model
- Stakeholder Workshops 2, 3 and 4 will focus on varying time frames and DER conditions/penetration
- LSAM™ will facilitate utility-specific analyses and scenarios to inform rate related decisions
- Web dashboard interface for all users in workshops

LSAM™ INPUTS AND OUTPUTS

TO BE CUSTOMIZED BASED ON STAKEHOLDER FEEDBACK

Examples

INPUTS

- New electric rate structures and/or pricing
  - Price elasticity of electric demand
- Scenario-based projections of DER market indicators, e.g.:
  - Installed costs
  - Policy considerations
  - Technology maturation rates and adoption

OUTPUTS (Pre and Post Inputs)

- Adjusted projections of load
  - Peak demand and energy
    - System and class load factor
  - Hourly load shapes
- Load duration curve(s) and power supply and RNS costs
  - Class contribution to ISO-NE and RNS capacity requirements
- Class and system revenue

LSAM™ DEMONSTRATION

BREAKOUT EXERCISE #1:
LEVERAGING RATES TO DELIVER VALUE

EXERCISE #1: STATUS OF RATES IN VERMONT

Instructions:

- Workshop will break into groups (by table)
- Take 20 min to discuss as a table. In support of State energy related goals:
  1. What are the 3 biggest opportunities for using innovative/emerging rates to create value for utility systems and their rate payers?
  2. What are the 3 biggest implementation issues and challenges we must address to realize that value?
  3. Extra Credit: From your individual perspectives (e.g., utility, 3rd party/industry organization, state) are you aligned in the opportunities / issues? If not, what is the biggest difference?
  4. Select 'spokesperson' to report findings to workshop

LUNCH BREAK

BREAKOUT EXERCISE #2:
DEVELOPMENT OF KPI / CRITICAL SUCCESS FACTORS

EXERCISE #2: KEY PERFORMANCE INDICATORS

- Instructions:
  - Workshop will break into groups (by table)
  - Take 35 min to discuss as a table. Review your Case Study (ST, MT, LT) and conditions.
    1. Review the initial KPIs for the Case Study, are there any refinements, additions or modifications you would recommend?
    2. What are 2 Critical Success Factors or "Fatal Flaws" in managing or optimizing the Case Study? (e.g., large storage availability, high penetration / customer adoption, direct utility controlled, etc.)
    3. Select spokesperson to report to workshop

SESSION WRAP-UP

SESSION WRAP-UP

- Summary of objectives
- Next steps for LSAM™
  - Data from utilities
  - Modeling rate alternatives
- Next steps for Stakeholder Groups
  - Volunteer Team to guide process
  - Rates / Rate characteristics to analyze in LSAM™
  - Model review / collaborative evaluate strengths / weaknesses
- Assignment for All: Be prepared to offer rate options